Geophysical Research Abstracts
Vol. 18, EGU2016-5735, 2016
EGU General Assembly 2016

Numerical solution of the exterior oblique derivative BVP using the direct BEM formulation

Róbert Čunderlík, Róbert Špir, and Karol Mikula

Dept. of Mathematics, Faculty of Civil Engineering, Slovak University of Technology, Bratislava, Slovakia (cunderli@svf.stuba.sk)

The fixed gravimetric boundary value problem (FGBVP) represents an exterior oblique derivative problem for the Laplace equation. A direct formulation of the boundary element method (BEM) for the Laplace equation leads to a boundary integral equation (BIE) where a harmonic function is represented as a superposition of the single-layer and double-layer potential. Such a potential representation is applied to obtain a numerical solution of FGBVP. The oblique derivative problem is treated by a decomposition of the gradient of the unknown disturbing potential into its normal and tangential components. Our numerical scheme uses the collocation with linear basis functions. It involves a triangulated discretization of the Earth's surface as our computational domain considering its complicated topography. To achieve high-resolution numerical solutions, parallel implementations using the MPI subroutines as well as an iterative elimination of far zones' contributions are performed.

Numerical experiments present a reconstruction of a harmonic function above the Earth's topography given by the spherical harmonic approach, namely by the EGM2008 geopotential model up to degree 2160. The SRTM30 global topography model is used to approximate the Earth's surface by the triangulated discretization. The obtained BEM solution with the resolution 0.05 deg (12,960,002 nodes) is compared with EGM2008. The standard deviation of residuals 5.6 cm indicates a good agreement. The largest residuals are obviously in high mountainous regions. They are negative reaching up to -0.7 m in Himalayas and about -0.3 m in Andes and Rocky Mountains. A local refinement in the area of Slovakia confirms an improvement of the numerical solution in this mountainous region despite of the fact that the Earth's topography is here considered in more details.